

QUANTITATIVE METHODS (INC. MODELING & SIMULATION)

Assignment 1

Name: Jairus M. Espiritu
Year & Section: III – AINS

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Professor: Mr. Nino Narido

Simulation Tool:

- Visual Studio Code
- Python + SimPy
- Matplotlib (For Animation)

Simulation Project: Bank Simulation

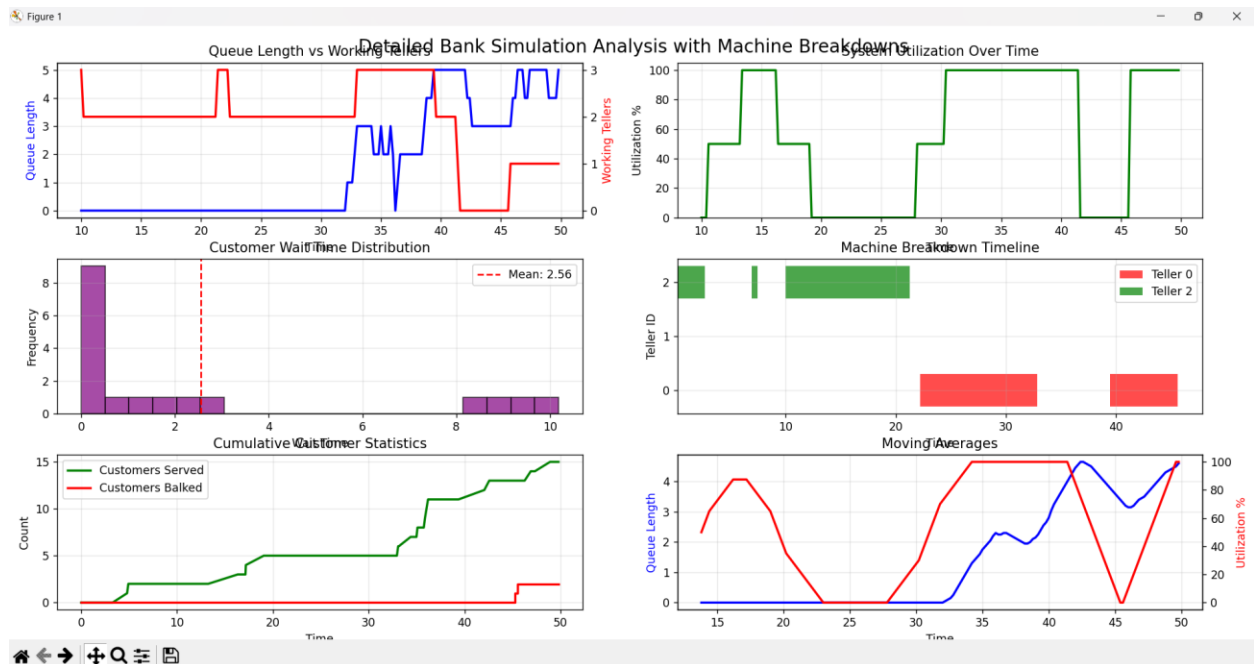
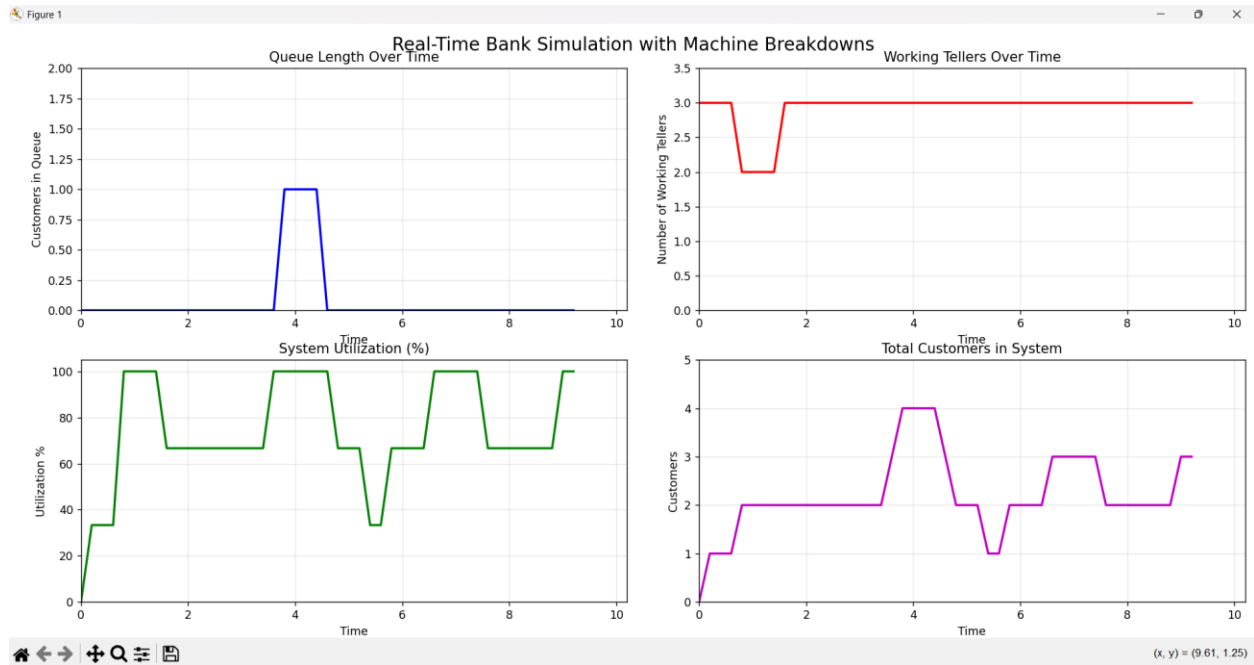
The simulation imitates a bank queue simulation. It simulates the random arrival time of customers, bank tellers with conditions if the machines are broken or fixed, customer service process, queue management and statistics collection. The simulation also includes a line graph for visualization.

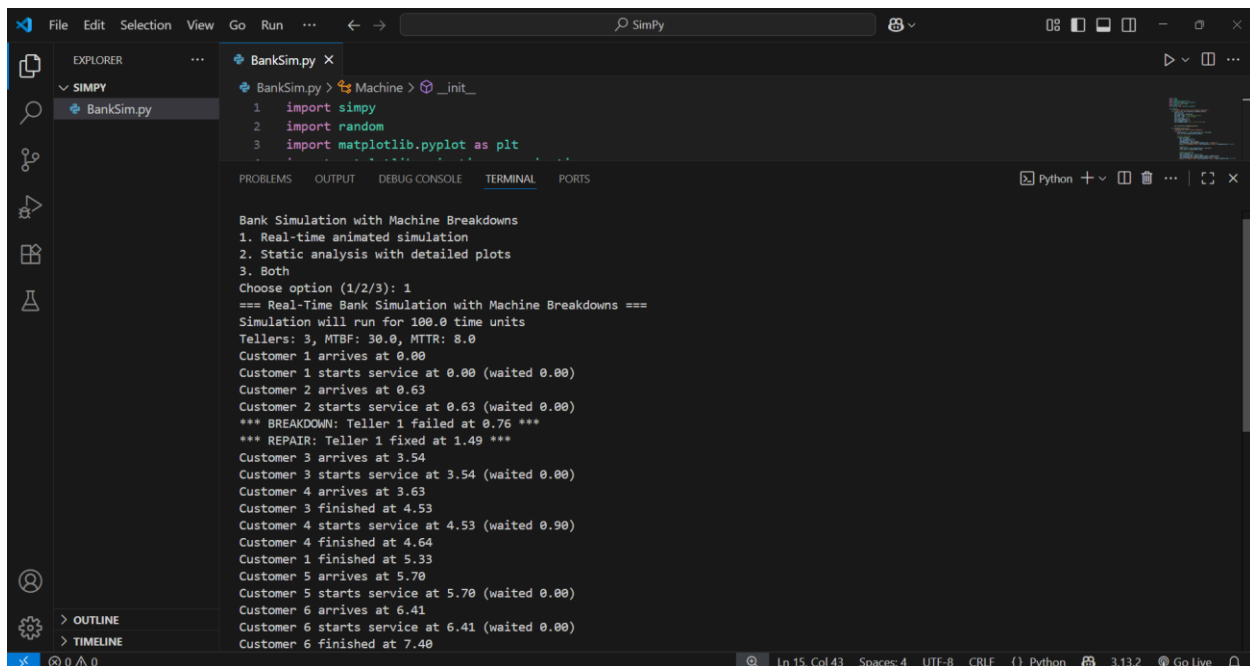
Simulation Sample Output:

The screenshot shows a VS Code editor window with the following components:

- Explorer Panel:** Shows the file structure with a folder named `SIMPY` containing the file `BankSim.py`.
- Editor Panel:** Displays the contents of `BankSim.py`, which includes imports for `simpy`, `random`, and `matplotlib.pyplot`, followed by a `__init__` function.
- Terminal Panel:** Shows the command `PS C:\SimPy> & "C:\Program Files\Python313\python.exe" c:\SimPy\BankSim.py` and the output of the script, which lists three simulation options: 1. Real-time animated simulation, 2. Static analysis with detailed plots, and 3. Both. The prompt `Choose option (1/2/3):` is visible at the bottom.

Before the simulation begin, the user can choose if he/she only wants a real time animated simulation, static analysis with detailed plots or both.





The screenshot shows a Visual Studio Code editor window with a file named `BankSim.py` open. The file is located in a folder named `SIMPY`. The code in the file is as follows:

```
1 import simpy
2 import random
3 import matplotlib.pyplot as plt
```

The terminal output shows the execution of the simulation. It starts with a menu for "Bank Simulation with Machine Breakdowns" and a choice of options. The simulation runs for 100.0 time units. The output shows the arrival, service, and completion times for six customers, as well as a machine breakdown and repair event.

```
Bank Simulation with Machine Breakdowns
1. Real-time animated simulation
2. Static analysis with detailed plots
3. Both
Choose option (1/2/3): 1
=== Real-Time Bank Simulation with Machine Breakdowns ===
Simulation will run for 100.0 time units
Tellers: 3, MTBF: 30.0, MTTR: 8.0
Customer 1 arrives at 0.00
Customer 1 starts service at 0.00 (waited 0.00)
Customer 2 arrives at 0.63
Customer 2 starts service at 0.63 (waited 0.00)
*** BREAKDOWN: Teller 1 failed at 0.76 ***
*** REPAIR: Teller 1 fixed at 1.49 ***
Customer 3 arrives at 3.54
Customer 3 starts service at 3.54 (waited 0.00)
Customer 4 arrives at 3.63
Customer 3 finished at 4.53
Customer 4 starts service at 4.53 (waited 0.90)
Customer 4 finished at 4.64
Customer 1 finished at 5.33
Customer 5 arrives at 5.70
Customer 5 starts service at 5.70 (waited 0.00)
Customer 6 arrives at 6.41
Customer 6 starts service at 6.41 (waited 0.00)
Customer 6 finished at 7.40
```

Real-time bank simulation with visualization and output in the terminal. It shows the arrival time of the customer; waiting time, time of transaction, and the time when the transaction is finished. The simulation also includes the breakdown and repair time of the machine.

Virtualization Sample Recording:

https://drive.google.com/file/d/1AW9L5NnAdTkSS08B_yaVzj2mPx3jkiup/view?usp=sharing